PROGRESS REPORT

TO

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

ON

CONTRACT NO. NASr-82

CONSTRUCTION OF A 60-INCH LUNAR AND PLANETARY TELESCOPE

by

Gerard P. Kuiper

Lunar and Planetary Laboratory

University of Arizona

Tucson, Arizona

October 1, 1964

PROGRESS REPORT

ON

CONSTRUCTION OF A 60-INCH LUNAR AND PLANETARY TELESCOPE

Gerard P. Kuiper

Lunar and Planetary Laboratory, University of Arizona

1. Introduction

The progress report dated March 1 reviewed (1) the history of the project; (2) the site; (3) the decisions on the 60-inch optics and their production; (4) telescope mount and drive; and (5) 60-inch building and dome.

The progress since March 1 has been satisfactory, with the program moving essentially according to schedule. The optics is now good to about $\lambda/4$ and could already be used if necessary. It is scheduled for completion this fall. The telescope mounting will be done by the end of 1964, and the 60-inch dome and building by 10 January 1965. Particulars are given in the sections below. Section 2 was written by the Chief Optician, Mr. Robert Waland, Section 3 by our Engineer and Designer, Mr. Sam Case.

2. Optics

The F/4, 61-inch full-aperture paraboloid for this project is in the final critical stage of figuring. This art involves the removal of glass by polishing laps to impart to the optical surface the correct theoretical form necessary to remove the spherical aberration for remote objects. This would destroy the critical defining properties of the system, which is the chief aim in this project.

To date this figuring progress looks extremely promising. Under the Foucault knife-edge test at the center of curvature, the figure appears to be a perfect surface of revolution. This can be a limiting factor in large aperture mirrors. At the moment the estimated accuracy is $\lambda/4$ of the full parabolic correction. No quantitive tests have yet been made at this fluid stage.

A null lens has been designed and made in our optical shop. The function of this optical component is to remove the spherical aberration present in a perfectly corrected paraboloid when tested at its center of curvature (a procedure necessary in the limited confines of an optical shop). This enables the optician to see very fine changes of slope which would otherwise escape his attention. This lens has been used with very promising results.

It is our intention as the work proceeds, and the surface errors reduced, to use the caustic* method of testing. This enables the optician to assess slope errors down to $\lambda/100$. This is more searching than the Foucault knife-edge test with its imposed limit of $\lambda/40$.

The slope errors of $\lambda/4$ estimated to exist on the surface at the date shown above are very gradual. This makes the problem of correction much simpler.

---

*"On the errors of testing and a new method for surveying optical surfaces and systems" by Platzeck and Graviola. Journal of the American Optical Society, Vol 29, page 484, 1939.

The two hyperbolic convex secondary mirrors giving focal ratios of F/45 and F/13.5 are completed except for figuring. Since these surfaces form no real images without the primary paraboloid, the standard procedure of testing these secondaries with a short-radius spherical mirror will be adopted. A sphere of at least 50-inches aperture will be loaned to the Laboratory through the good offices of the Kitt Peak National Observatory, and work on the figuring of these mirrors will run concurrently with the final figuring of the 60-inch primary.

3. Mounting

The 60-inch telescope mounting includes the following items: telescope tube, primary mirror cell, F/45 secondary mirror support, F/13.5 secondary mirror support, 1-inch plate-glass girder ring, instrument-mounting plate; declination axis, shafts, bearing, and housings; yoke (polar shafts, bearings, bearing places, counter weight, and pre-load); right ascension drive, gear and worm (this includes both slewing and tracking), declination drive, gear and worm (this includes both fast and slow motion). The construction of these components was awarded to the Western Gear Corporation, of Lynwood, California, on September 1, 1964. The estimated time of completion, including erection on site, is approximately 20 weeks, i.e., from September 1 or about January 15, 1965. The bid price of fabricating the above, including erection on the job site, was $89,070. Our estimate for the job had been $89,000.

Western Gear Corporation is a large gear-manufacturing plant, and they are capable of doing a variety of fabrication. They have in the past made several large-diameter gears for telescopes, among which is the right-ascension gear for the 84-inch telescope at Kitt Peak. At present they have some 50 people working on the 60-inch telescope. The work is progressing ahead of schedule and we do not anticipate any major problems. The primary mirror cell is the first part being fabricated in order to enable the University to install the mirror floatation system in it.

We have been in frequent contact with Western Gear Corporation and they have tentatively set the site-erection of the telescope for late December 1964. This will allow us about a month to make the adjustments necessary to the telescope and complete the control wiring somewhat before the Mars opposition takes place.

The primary mirror floatation system, consisting of some 1100 pieces, is being fabricated in the Physics Machine Shop of the University. The floatation system is about 90% complete and will be ready by the middle of November, for installation in the cell.

The good progress now being made in the fabrication of the telescope will enable us to have the mechanical parts of the telescope checked over and in full operation by the middle of February 1965. An angular precision of 0".5 (seconds of arc) is the goal we have set for the accuracy of the telescope drive.

The following assembly drawings, one set of which is herewith enclosed, were not included in our March 1, 1964, report or they have been revised.

Figure I.	Revised Sectional Elevation of the 60-inch Telescope
Figure II.	Mirror Cell, Radial Support Assembly
Figure III.	Mirror Cell, Center Defining Assembly
Figure IV.	Mirror Cell, Jacking Support Assembly
Figure V.	Mirror Cell, Axial Support Assembly
Figure VI.	Mounting Plate Assembly
Figure VII.	Mounting Plate Assembly

4. Building and Dome

The building and dome are being constructed from University funds. The contract was awarded to Irving D. Rubinstein General Contractor on August 6, 1964, and the bid price was $169,395. This does not include charges for site preparation, roads, sewers, water system, etc., also covered by the University funding.

As outlined in the March 1 report, the building will have two floors. The construction of the building is progressing on schedule. The outside columns are now erected and all the footings are poured. Two photographs showing the early construction phase, are enclosed. The north and south steel piers will be erected during the 3rd week of October 1964. We anticipate no problems in construction of the building.

The dome was subcontracted to the Astro-Dome Company of Canton, Ohio, one of the largest dome-manufacturing companies in the U. S. The dome will be erected on the 60-inch telescope building about mid-December 1964. Completion date of the dome and building will be January 10, 1965. The construction schedule is given in detail in Figure VIII.